THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 150.

THE NEW THEORY OF TERRESTRIAL MAGNETISM.

IN our issue for the 1st March, we gave a preliminary notice of the new theory of terrestrial magnetism developed by Professors Ayrton and Perry. All previous explanations of the earth's magnetism have been based either on the existence of one or more permanent magnets inside the earth, or on thermal electric currents produced by the rotation of the earth under the sun's action. But the thermal currents thus generated would probably be totally insufficient to account for the earth's magnetism; and we have no reason, beyond the fact that the earth acts as a magnet, for assuming the existence of permanent magnets in its interior. The newly proposed explanation, however, differs from all that precede it, in that it requires *solely* the rotation of the earth and a static charge of electricity on its surface as its elementary conditions. As regards the existence of the first condition—the earth turning round on its axis—there can be no doubt; and the second—that the earth is a charged body—is more than probable; for many phenomena lead us to conclude that the various bodies of the solar system have different electric potentials, therefore, some, or all of them must have independent electric charges. And not only this, but Sir Wm. Thomson has concluded, as the result of many experiments, that all the phenomena of atmospheric electricity ordinarily observed, would be just the same as they are if the earth were *negatively* electrified and the atmosphere without charge. Now such a *negative* charge would, as explained by Profs. Perry and Ayrton, not only by its mechanical rotation produce a magnetic potential inside and outside the surface of the earth, but would cause our small magnets to be deflected in the same direction as we now see them. For since the marked poles (English, north; French, austral) are deflected towards the north, the earth's magnetic pole in the northern hemisphere must be of course an unmarked pole (English, south; French, boreal), and to produce such a pole would require a positive electric current to flow from east to west round the earth, or a negative current from west to east, that is, with the earth's motion.

It will naturally be asked why, if the fundamental conception of the proposed theory is so simple, was it not thought of before? The reason of this is, that it was not until it was experimentally proved in Prof. Helmholtz's laboratory in 1876, that a quantity of electricity in mechanical motion relatively to a magnet, deflected it, that attention would be turned to the consideration of the electromagnetic effects that must arise from the mere rotation, round an axis, of any body of any material having an electric charge. Or again, it might be objected that in the experiments described by Prof. Helmholtz, the magnet, which was deflected, was at rest while the electric charge was in motion, whereas, in the earth all parts are moving at the same rate, and, therefore, that the electric charge on the surface could not produce magnetism in the interior. The answer to this is, that all points in the earth are undoubtedly moving with the same *angular* velocity, but not with the same *linear* velocity; therefore, the various parts have relative motion one to the other, the amount and direction of which has been mathematically determined by the Authors in their paper; and the rather curious result has been arrived at, viz., that in the earth, the motion of *any* point on the surface *relatively* to any point inside, is always in a line perpendicular to the line joining the two points.

There seems, therefore, every reason for accepting the fundamental idea that if the earth be electrically charged, it must, from the very fact of its revolution, be magnetic; and the fact that Profs. Ayrton and Perry have proved, by close mathematical analysis, that if there be an iron shell thick or thin in the earth, that the distribution of magnetic intensity arising from their theory will be that known to exist from experiments, only adds additional weight to the theory.

One of the great difficulties in connection with terrestrial magnetism has been to explain the well-established connection between terrestrial magnetic disturbances and celestial phenomena, but now that terrestrial magnetism has been made to depend on the static electric charge on the earth's surface, we realise that any change in the dielectric between us and the sun must alter the electrostatic induction of the sun on the earth, therefore the static electric distribution on the earth's surface, and, consequently, terrestrial magnetism. Hence, since the sun and other members of the solar system may very likely have potentials so different from the earth that we can hardly conceive the amounts, we should expect that the earth's magnetic intensity would vary as do the ocean tides; and this is known to be the case. Again, it is also evident that, besides these regular changes, every time a great mass of vapour is suddenly formed and condensed on the earth, or whenever great changes are occurring in the solar

atmosphere, whereby the lines of *electrostatic induction* from the sun to the earth are altered, we should find corresponding changes in terrestrial magnetism, such as we now know as magnetic storms. And not only this, but, as the planets are charged bodies, their motions relatively to the sun ought to cause motions in the sun's atmosphere, such that, for instance, the allineation of a number of planets and the sun, or the near approach of any planets to the sun, if the alligned or approached planets have potentials nearer that of the sun than many of the other bodies of the solar system, ought to diminish the storms in the solar envelope, and ought to alter the electrostatic distribution on the earth. But it has been ascertained from repeated observations that the near approach of a planet to the sun both affects the sun's spots and terrestrial magnetism.

CROSSLEY'S MODIFICATION OF THE HUGHES MICROPHONE.

By WALTER EMMOTT, Assoc. Soc. T.E.

No sooner was the telephone in the market than various attempts were made to adapt it to a wider sphere of usefulness than the act of simple conversation between two stations—for example, to the transmission of speech from a lecturer at some distance from the transmitter; but the instrument could not be made equal to the task; it was practically useless unless when spoken into, and the public speaker who would undertake to speak at such a mark was not to be found.

The discovery of the microphone by Professor Hughes, however, supplied the necessary auxiliary, as it was found that sounds made some distance from the microphone could be distinctly heard on the telephone, and Mr. Louis J. Crossley, of Dean Clough, Halifax, commenced to experiment with it in this direction.

Microphones of every conceivable form and material were made, and some very strange and unexpected results obtained; but, as a record of these experiments, which have been carried on for about ten months, would occupy too much space, we will only explain one form of microphone which has been found perfectly to answer Mr. Crossley's requirements, which were as follows :—

1. The instrument must be sufficiently sensitive to transmit clearly to a Bell's telephone at least three miles away every word spoken in a moderate tone of voice when the speaker stands some distance from, and not even facing, the instrument.

2. It must not be liable to get out of adjustment by a severe shake.

3. It must be capable of working by not more than two cells, and the sounds received in a telephone three miles away must be at least as loud, and the articulation as good, as when speaking closely into a very good telephone.

These requirements have been fulfilled most perfectly by an instrument arranged as per fig. 1, in which *a b c d* are four pencils of carbon loosely held in four carbon blocks *d e f g*, and connected in circuit with a battery and the primary wire of an induction coil as shown. The line is connected to one side of the secondary, the other side being to earth through the telephone.

This form of microphone is mounted upon a piece of wood (pine answers well) and is then covered with another thin piece of wood, which under certain circumstances gives better articulation.

As a means of thoroughly testing this form of microphone, it has been worked daily for some weeks past against a number of other microphones, over 18 busy telephone circuits, and has been found to give the best results; it not having failed even once.

As an addition to the telepone it is very valuable, almost any intensity of sound being attainable. An audience of 600 persons have heard distinctly (from a good telephone) words spoken upwards of half a mile away. The annoyance of speaking loudly into a telephone is also avoided as a whisper can be heard by means of the microphone.

The most interesting application of the instrument, however, has been the transmission of the services from a church in Halifax to a distance of three miles by wire every Sunday for some months past; in fact, it was for this purpose that the instrument was first designed, and it has worked well in this capacity although placed under most unfavourable circumstances, being stationed within a foot of the bottom of the pulpit and nearly behind the minister. This was the only available position to be had, as the instrument requires to be so fixed as not even to attract the attention of a stranger in the pulpit, much less the congregation. When this mode of assisting the chaplain in his capacity of preacher has become a recognised institution, we may hope to place our instruments at least a little more to the front.

On Sunday, April 13th, a wire was connected up by Mr. E. C. Warburton (Engineer and Superintendent of the Telegraph Department of the Lancashire and Yorkshire Railway), between his office in Victoria Station, Manchester, and the Square Church, Halifax, a distance of 36 miles. At Halifax it was joined on to the church wire, and a number of electricians and others interested in the science met at Mr. Warburton's office for the purpose of hearing the service from the church 36 miles away.

As the wire ran side by side with some 25 or 30 others at the Manchester end, there was a fair amount of induction, and the results were somewhat marred by this effect, and, especially, by the induction of a more than usually noisy Morse circuit, which came on at intervals with a bang. However, during the intervals of moderate quiet a large part of the sermon and even of the prayers were heard and reported.

The musical part of the service was beautifully rendered throughout, being audible over and above even our uproarious enemy; the fine tones of the organ and the singing being heard from a good telephone some yards away from the mouthpiece.

After the service, several experiments were made, from which it was agreed by all, that if the transmitter could have been placed opposite the speaker, every word would have been heard distinctly over and above any ordinary amount of induction.

FIG. 2.

FIG. 3.

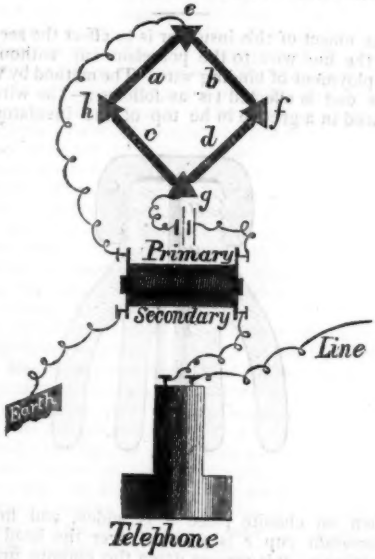


FIG. 1.

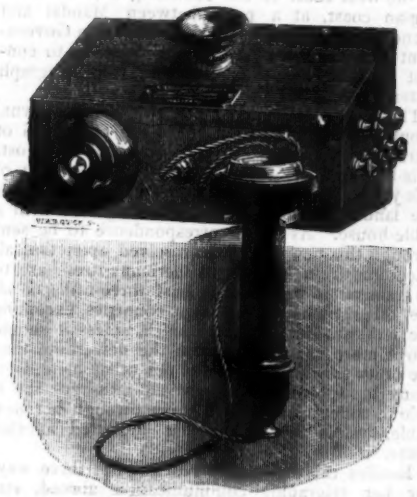


FIG. 4

In the evening one of our private wires,* from Halifax to Bradford (a distance of 10 miles by wire), was joined to the church, and the whole of the service was distinctly heard and reported with ease.

Fig. 2 exhibits a complete form of instrument for use with the telephone. When the telephone is in the position shewn, the line is switched direct on to the bell, the battery being disconnected from the microphone and switched on to the key seen at the right-hand side, for ringing up the distant station.

By lifting up the telephone to speak, the microphone and telephone are brought into circuit.

In a quiet office no bell is required, as it is only necessary to call out rather loudly to be heard, nor is it necessary to speak directly into the mouthpiece of the transmitter.

Fig. 3 shews the same instrument with the front off, and is sufficiently clear to explain itself. The induction coil will be seen below, as also the hook on which the telephone hangs, while the microphone is fixed in the wooden chamber above.

Fig. 4 shews another and cheaper form of instrument.

The Bell telephone is shewn in connection with these instruments, though Mr. Crossley has succeeded in producing an independent receiver for his instrument, but has not yet been able to reduce it to so neat and handy a form as that of Bell's instrument, although he expects shortly to accomplish this also.

THE NEW GERMAN-NORWEGIAN CABLE.

AT a recent conference held in Christiania, it was agreed between the representatives of the German Empire and the two Governments of Norway and Sweden, that Germany shall, at her own cost, lay down a three-wired cable from Romoe, an island off the west coast of the Schleswig and the Norwegian coast, at a point between Mandal and Arendal. From that place the Norwegian Government undertakes to carry the line on so as to connect it with the whole Scandinavian telegraph system.

The cable is estimated to cost two million crowns, about £95,000, and it remains in the possession of Germany who has also to repair it at her own cost. It is further specified to be laid by October 1st of this year. Norway is to put up a new wire from the landing point to the capital, together with a cable-house. As to the correspondence to be sent through this new cable, it is resolved upon that all telegrams from Norway to Germany itself, are to be transmitted by it, and at least three-fifths of all the other traffic with foreign countries, excepting the Russian, English and Danish, unless it should prove more expensive to use the new route than the other existing ones. On the other hand, Germany has power to forward all messages she is able to collect and forward them through her new cable, unless the sender has indicated another route.

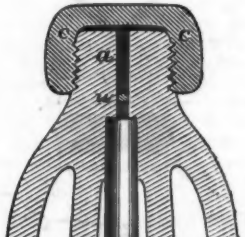
Besides this new cable Norway has three ways for her telgraphic communication abroad, viz., through Sweden and by cable from Trelleborg to Rügen, from Arendal to Fredericia in Denmark (cable to Hirtshals), and from Ekersund to Peterhead in Scotland, this last being reserved for her English traffic. If the new line is slower than the existing ones, Norway has a right to forward her telegrams by the best route. Besides, Norway may become free to forward her telegrams by any way she choses by purchasing one-half of the cable, or by giving notice to the convention at the end of 20 years. Norway has a very large correspondence with all sea-faring countries because of her extensive mercantile navy, and it is said that the correspondence of Germany with Norway is second only to her correspondence with England.

Hitherto Germany has been obliged to send her telegrams to Norway through Denmark and Sweden, a course which has been manifestly irksome to her, owing perhaps in part to the uneasy political relations between her and the Danes. In 1878 she tried to effect an arrangement similar to that which has just been concluded, but Norway refused because of the great expense which she was then asked to share. The new scheme will, of course, deprive Denmark of the traffic which formerly passed over her lines between Germany and Norway; and, seeing that the present means are ample for the necessities, the Danes are disposed to regard the new act of the German Government as proceeding from a desire to have a line of their own, in case of war between Germany and their own country. This idea was also expressed in the Norwegian Storthing or Parliament, when the Government asked for the money for the new line.

* Blakey Bros. and Emmott.

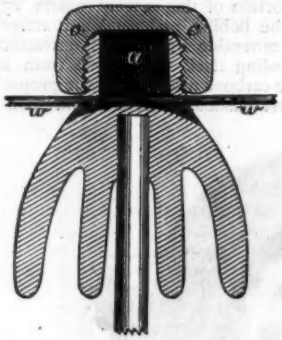
CREIGHTON'S IMPROVED INSULATOR.

THE object of this insulator is to effect the securing of the line wire to the porcelain cup without the employment of binding wire. The method by which this end is effected tis as follows :—The wire *w* is placed in a groove in he top of the insulator, and



then an ebonite piece *a* is added, and finally a porcelain cup *c* is screwed over the head of the insulator; this presses down the ebonite firmly on the wire and jambs it tight in the groove. In order to effect this object more thoroughly, the lower part of the groove is curved, as shown, so that the line

wire only bears on a small surface, whilst the piece of ebonite being slightly hollowed on its under surface has a tendency, when firmly pressed down by the cup, to slightly bend the wire over the curved portion of the groove, and thereby to give the wire a tighter grip. In addition to the care



with which the wire can be thus secured, this method possesses advantages as regards insulating properties, for the wire being only in contact at a few points with the porcelain has practically a greatly diminished amount of leakage as compared with wires secured by wire bound completely round the insulator.

LONTIN'S ELECTRIC LIGHT

WE are indebted for the following account of M. Lontin's system of electric lighting, which has been on view all the winter at the Gaiety Theatre, Strand, to the Count du Moncel's excellent new treatise *L'eclairage Electrique* (Hachette & Company):—

In the Lontin machine for apportioning the electric light, we have a means not only of dividing the light, but of distributing it among several jets to any convenient intensity, while making some of these profit by the feebleness of the rest.

In principle the machine consists of a series of electro-magnets fixed in the inside of an iron crown arranged vertically, and in the centre of which rotates an electro-magnetic system composed of as many magnetic cones as there are electro-magnets on the crown. The fig. represents this machine, in which the moveable interior electro-magnetic system represents the *inductor*, and the fixed exterior system the *induced* coils.

The inducting system is composed of an iron cylinder upon which are riveted a number of iron plates resembling the teeth of a pinion, on which are round wire helices A A connected up for tension. In order that the spires of these helices do not shift under the influence of centrifugal force and expansion by heating, the iron plates forming the cores are made thicker at their free ends than at their junction with the axle, and hence serve for retaining washers to the coils. Horizontal cross-pieces mounted on two bronze wheels, and against which they abut, otherwise maintain them in their position. In fine, the winding of these helices is so contrived as to reverse the polarity of alternate plates, so that the movement of the drums successively brings a different magnetic pole in front of the iron cores of the induced system, which is thus polarised alternately.

The inducting system is kept magnetised by the dynamo-electric generator which we have above described,* and which may be mounted or not on the same axis. A battery or another machine may be substituted for this generator, but the latter is more economical.

The induced system consists, as we have seen, of a great ring of iron *b b*, immovable, and furnished inside with a series of iron plates fixed across the field, like the teeth of a wheel gearing internally and wound with magnetic helices B B B. These helices are connected together in pairs so as to form a complete magnetic system, and their free ends come to the commutator M, which permits the currents to be gathered either separately or collectively, by means of rubbers *a s*. In the interior of this ring turns the inductor which is so disposed that the magnetic cores of the two systems pass each other without touching. Thus each induced core is magnetised alternately, for if one of the inducing cores has North polarity, the neighbouring induced core will have South polarity, which will produce a corresponding current in the coil. When the inductor has advanced, the magnetism that it had determined in that induced core will be reversed, since the polarity of the next inducing core is contrary to that which went before, and the result will be a reversed current in the coil. As this action repeats itself simultaneously over the whole system of induced electro-magnets, each of these will be able to furnish its own alternate current. Admitting that each induced system of two coils is capable of feeding one electric lamp, the machine figured will supply twelve lights, and, if we wish to obtain these of different intensities, it suffices, by means of the commutator M, to join the coils so as to get greater or less strength of current.

The commutator M is arranged to react upon as many of the contact plates as there are utilisable currents. The number of these currents depends upon the construction of the machine, and we have seen that the machine illustrated gives twelve. There are, therefore, 12 contact-plates, and to each of these there are two corresponding terminals; one connected to the contact itself, the other to a hand key I. The first receives the wire of the corresponding magnetic system, the second the wire which runs to the electric lamp. Besides this, the different contacts are themselves provided with hand keys, which connect them two and two and permit of instantly joining or separating the partial current.

This machine has been applied during some time to the lighting of the *Gare de Lyon*, where it furnishes 31 lights from a single generator and two induced systems of 24 bobbins each. In joining together these coils, and interposing in each of their circuits several Lontin regulators, M. Lontin has been able to get these 31 lights, each of which is equivalent to 40 Carcel burners.

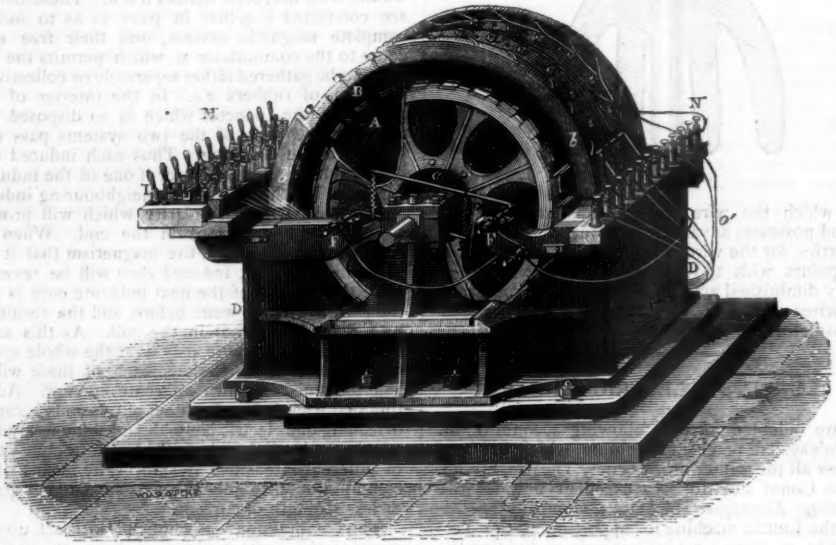
For six months these machines have also been

* This consists of an axle from which project four circles of iron spokes wound with coils connected together in two separate circuits round the axle and to the commutator after the manner of Gramme's ring. These are revolved between two upright flat electro-magnets fed on the accumulation principle.

installed at the *Gare St. Lazare*, where they light 12 lamps, two of which, situated at the entrance to the station, are 700 metres from the machine, a fact which refutes the assertions which have been made to the effect that alternating currents would not produce light beyond 200 metres.

We extract from a published description of the Lontin machines, the following account of the Lontin Lamp :—"The first and chief advantage of these regulators is that the moving and regulating parts are so constructed that the lamp can operate in all positions—upright, horizontal, and even inverted, without stopping. The novel application which has been made in these regulators of a metal wire, which acts by the heating due to the passage of the current, and maintains the arc rigorously constant, permits of the suppression of electro-magnets (whose resistance interposed in the circuit, caused a notable increase in the expense of the electricity), and allows of a more regular light.

"The approach of the carbons in proportion to their waste, is obtained by applications not less happy, namely, the employment of a derived current taken from the lighting current itself. In the apparatus there is fixed a solenoid, formed of a bobbin wound with fine wire, offering a high resistance to the current. This bobbin encloses a moveable core of soft iron, which, when passive, arrests the motor mechanism of the carbons. Whilst the arc keeps its proper width, all the current passes by the carbons, because of the great resistance it encounters in the bobbin ; but, when the arc increases, a small portion of the current passes by the fine wire of the bobbin and renders it active. In this case the moveable iron core is attracted, and the motor, finding itself disengaged from its detent, brings the carbons nearer until the proper length of arc is re-established. The solenoid then ceases to act, and the iron core arrests the motor again. This motor, having only to move the carbons, is very simple in construction."

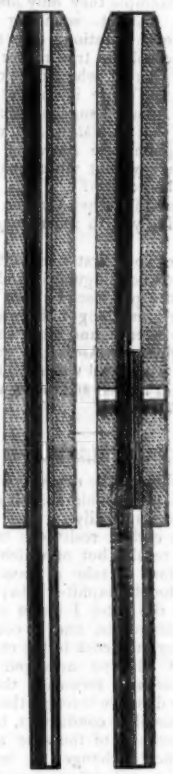


This use of a derived circuit can be equally applied with advantage to all regulators which produce of themselves the gap between the carbons, and renders their action sure and regular, whatever the variations of the current. This system has also been applied with success to the regulators of M. Serrin installed at the *Gare St Lazare*, the Paris terminus of the *Chemin de Fer de l'Ouest*. We may add to the Count du Moncel's above account, that these machines are made in England, by Messrs. Latimer Clark, Muirhead & Co., of Westminster.

LUGO'S ELECTRODES FOR ELECTRIC LIGHT.

THE improvement here illustrated is one of the latest of its class, having been patented as recently as September last (by Orazio Lugo, of Flushing, N.Y.). The engraving represents but two of several modifications, all of which include, as a leading feature, the introduction of air or other fluid into the electric arc in order to keep the electrodes cool and retard their consumption. They are made of the usual carbon, or any suitable material. The invention consists in either making the electrodes tubular, or in combining each of them with a tube which is wholly or partially surrounded by the carbon or other material of which the electrode is composed, for the purpose of affording a channel through which air or other fluids may

be conducted, and may be discharged from the points of the electrodes into the electric arc. In the practice of the invention the tubular electrodes may be open at both ends, and reliance had upon the natural draft for creating a current of air through them; or they may be connected with pipes, through which air or any desired fluid or fluids is forced from a distant locality into and through the electrodes with any given pressure. The inventor



states that he preferably incases the tubular carbon electrodes in a metallic shell, for facilitating their electrical connection with the plus and minus wires of an electric circuit, supplied with a current from a battery or other source of electricity. Further, instead of arranging them vertically, in direct line with each other, it is preferred to have them side by side, with their upper ends inclined towards each other.—*Useful Arts.*

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

To the Editor of THE TELEGRAPHIC JOURNAL.

Permit me to criticise some of the statements and correct a few errors in your Review of my recent work on the "Speaking Telephone, Electric Light, and other recent Electrical Inventions," published in your issue of the 15th ultimo.

1. In writing the above-mentioned book, the object which I had in view was not "to advertise Mr Gray's claim to be recognised as the first and true inventor of the speaking telephone, nor to support the claim of Mr. Edison to the discovery of the microphone; but to present without favour or prejudice, all attainable facts relating to the electrical transmission and reproduction of sounds, and let the reader judge for himself just what measure of credit is due to each of the different explorers in this wonderful field of discovery.

To this end I have published all attainable records bearing upon the subject, including those of the four principal inventors, Gray, Edison, Bell, and Dolbear, without alteration or omission.

2. You say, "Mr. Gray was probably the first to conceive of a theoretically correct speaking telephone; but to Bell belongs the honour of achieving one. More than this, Bell did not simply succeed, where Gray failed, by adding some happy improvement to Gray's plan."

How could Mr. Gray's telephone fail if it was "theoretically correct?" If a theoretical device could not be made successful in practice, would it not necessarily indicate that the theory was incorrect? But Gray's telephone was not a failure, and instruments constructed in exact accordance with his original drawings and specifications, are good articulating telephones. Moreover, Mr. Gray's method of producing articulate speech by varying the resistance of a battery current is much more effective than that of Professor Bell subsequently invented, which depends upon magneto-induction currents generated by the action of the voice, as is fully proved by the great superiority of Edison's carbon telephone, which is based upon this principle.

3. Your statement that "Bell's telephone is entirely 'electro-magnetic,' (magneto-electric?) while Gray employs a battery," is misleading, as implying that Bell never used a battery with his method. Bell used a a battery, as he says, until "it was proved that the only use of the battery was to magnetise the iron core of the magnet," for the effects were equally audible when the battery was omitted, and a rod of magnetised steel substituted for the iron core of the magnet.* Regarding the change from the electro-magnetic to the magneto-electric method, Professor Bell says that, "Professor Dolbear, of Tuft's College, not only claims to have discovered the magneto-electric telephone, but I understand charges me with having obtained the idea from him through the medium of a mutual friend."

4. How do you know that "it was an *accident* that Bell's transmitter happened to be like Gray's earlier receiver?" or that "had the latter never existed at all, Mr. Bell would still have arrived *naturally* at that form?" Supposing this to be true, however, could not the same observation be made with equal propriety in regard to any other invention or discovery?

For example, could you not say, "it was an *accident* that Vespucci's more successful discovery happened to be like Columbus's earlier one. Had the latter never existed at all, Vespucci would still have arrived *naturally* at the discovery of America!"

5. How can Bell's be "a *totally different* instrument from Gray's," when they both use the same receiver? I have nowhere asserted that Professor Bell's telephone was *identical* with Mr. Gray's. On the contrary, I have stated distinctly that "in 1876, Bell invented an *improvement* in the apparatus for the transmission and reproduction of articulate speech, in which magneto-

* See *Researches in Electric Telephony*, by Professor Alexander Graham Bell, Journal of the Society of Telegraph Engineers, Vol. VI, No. 20, p. 406—410.

electric currents were superposed upon a voltaic circuit."

It no more detracts from Professor Bell's achievement that he employs a portion of Mr. Gray's invention to produce the *magneto telephone*, than it does from Mr. Edison that he employs a portion of Mr. Gray's invention to produce his *improved carbon telephone*—the same receiver being employed in all.

6. In the accounts which have been published of experiments with the microphone, the statement has frequently been made, that minute sounds are actually magnified by it, in the same sense that minute objects are magnified by the microscope. A little reflection will show, however, that there is no real analogy in the action of the two instruments. The sound that is heard in the receiving instrument of the microphone, when a fly is walking across the board on which the transmitter is placed, is not the sound of the fly's footsteps, any more than the stroke of a powerful electric bell, or sounder, is the magnified sound of the operator's fingers tapping lightly and, it may be, inaudibly, upon the key. This view of the subject readily explains why the microphone has failed to realise the expectations of many persons, who, upon its first exhibition, enthusiastically announced that by its aid we should be able to hear many sounds in nature which had hitherto remained wholly inaudible.

Referring to this idea that, faint sounds are not *augmented* by the microphone, you say that "this shows too well that Mr. Prescott does not know what a microphone is, and has never heard one. If Mr. Prescott has not himself heard minute sounds *transmitted* to a distance by a real microphone, why does he also disbelieve all the high authorities in this country who have?"

Is it possible that a reviewer who sets himself up to criticise the style and grammar of a book, as well as the accuracy of its statements, is unable to recognise the difference between *augmented* and *transmitted?*

Suppose that an apparatus could be so delicately arranged that the tread of a fly could be made to close an electric circuit and explode a powder magazine, would you contend that the force of the explosion was due to the *augmentation* of the power of the fly?

Permit me to close this brief notice of your review by quoting from its concluding paragraph. "It is a strange method this of writing a scientific review. Let us hope it is not common in England."

GEORGE B. PRESCOTT.

[While thanking him for his courtesy, I briefly respond to the above remarks of Mr. Prescott, under the heads he has adopted:—

2. Mr. Prescott knows as well as I do that correct mental conceptions are often difficult to realise from the imperfect materials obtainable and the practical inconvenience of the resultant form. In the case of Gray's telephone, for example, electrolysis of the liquid must hamper the theoretical action of the instrument, while batteries are inconvenient in private homes. If Mr. Gray's instrument is a truly practical success, why is it not in common use? Edison's carbon telephone is better than Gray's, but it is questionable if it is more effective than Bell's, for what it gains in loudness it lacks in definition.

3. Answers itself: the electro-magnetic telephone of Bell is also magneto-electric.

4. A study of Professor Bell's account of his researches show that he was naturally led step by step to a diaphragm. The example of Columbus and Vespucci is not apt since Vespucci followed Columbus, whereas Bell was working independently and simultaneously with Gray at the same problem. Had Vespucci sailed east and arrived at America, while Columbus sailed west, only reached the Indies, the parallel would have been better.

5. The principle of action in the two instruments is different.

6. Here again your analogy is somewhat faulty. The bell you introduce is an independent source of sound struck *mechanically* by means of the current, and would disguise any sound, just as a call-bell would disguise a telephone speech. In the microphone the *currents directly produce the vibrations of sound*, whereas in your example they only liberate a hammer which smites a distinct sounding body into its characteristic state of vibration. The sound vibrations acting on the microphone transmitter liberate corresponding pulses of current, which control the vibrations of the telephone, and cause it to imitate the original sound. You will admit, I suppose, that it is therefore legitimate to say that *audible* sound vibrations transmitted by microphone are *heard* in the telephone. How then can you say that vibrations *below the range of the ear* are not heard also?

Although *augment* is rather a vague word, I suppose I was right in taking you to mean *magnified*, or made audible.

With regard to your first and last observations, I may say that I was not singular in judging your book to be written for the purposes I stated; and so long as there seems to be some danger of mere money interest doing injustice to science, and violence to the rights of inventors, so long as any American writer appears to ignore European work and write as if only America existed, so long I trust will such reviews be written in England.—*The Reviewer.*]

THE DOMESTIC TELEGRAPH COMPANY.

SIR,—I have followed the recent controversy relative to the origination of variable carbon resistances, with much interest, and especially so, as I have been using for some time a carbon resistance tube which gives very satisfactory results, but of which, as yet, I have seen no description. I take a glass tube filled with very finely powdered graphite. In the cork which closes one end of the tube, I insert a small brass nail, which remains immovable, and is connected with the line wire. Through the cork in the other end I place a straight piece of wire so arranged that it can be pushed backwards and forwards, thereby increasing and lessening the distance through the powder between the ends of the metallic conductors, thus enabling me to vary the resistance of the line at will. By this method very delicate changes of resistance can be easily produced, as well as greater, the only limit to which is the length of the tube. I have also found these rheostats to be very constant and reliable, and believe they can be used satisfactorily where a pressure resistance would fail.

145, Broadway, New York, April 3, 1879. WM. HADDEN.

NEW METHOD OF SYNCHRONISING CLOCKS.

DEAR SIR,—Kindly correct a misstatement in your "Notes" of the 15th inst., where under the head of "Synchronous Clocks" you say that "we understand that it"—*i.e.*, some plan by Messrs. J. Edmundson and Co., "has been recently applied to the clock of St. James's, Piccadilly."

That clock is not made "sychronous" by any system, which would at best be wanting in any means for picking up automatically any possible error of the non-transmission of currents, but is "synchronised" on our Metropolitan system of Greenwich mean-time wires;

and on a plan, a modification of our original patent, the invention of Mr. George Lund, of Messrs. Lund and Blockley, our West End concessionnaires, by which not only is every minute error hourly corrected, but so accurately that the first blow of every hour, day and night, marks absolute Greenwich mean-time time to a second.

The insertion of the above will much oblige.

Yours very truly,

41, Cornhill, London, BARRAUD & LUND.
April, 18, 1879.

CLERAC'S TUBE.

SIR,—With reference to your note to Mr. Edison's letter in your impression of 15th inst., I beg to inform you that you are in error in supposing that "these new powers of the carbon telephone have been discovered since Professor Hughes published his researches on the microphone."

So far from this being the fact, I am in a position to assert that the date of my arrival in England with the carbon transmitter in its present form, antidates by two months the publication of Professor Hughes' researches at the Royal Society.

Apart from this fact, Mr. Edison and myself were aware for two years previously of the mircrophonic capabilities of the carbon transmitter, and it was in the endeavour to eliminate these characteristics from the instrument that so much time was consumed.

Yours truly,

JAMES ADAMS,
Assistant to T. A. Edison.

45, Avenue de l'Opera, Paris,
April 24th, 1879.

[Although the controversy on Clerac's Tube is practically closed, we give space to Mr. Adams' letter. It is a pity that these alleged microphonic effects, if really such, were not published until after the discovery of the microphone by Professor Hughes. Without stickling for this point of publicity, however, and for the sake of argument, admitting that the difficulties Mr. Edison encountered, in perfecting his carbon telephone, were microphonic ones, it appears to us that that fact only proves that Mr. Edison failed to see the great importance of the pertubations he wished to get rid of, and therefore missed, perhaps narrowly, the discovery of the microphonic principle. No unbiassed person can for a moment believe that so "smart" a man as Mr. Edison would have discarded a comprehensive discovery like the microphone, which in itself is far more marvellous and prolific than the carbon telephone, and, indeed, is found to include the latter, and to explain its action. It is evidently forgotten by Mr. Adams that the discovery of Professor Hughes is a property appertaining to contact under pressure between *any conductors soever*, carbon contacts simply being one instance. Had Professor Hughes begun his researches from the Edisonian stand-point, that is with carbon, he would probably never have discovered the general microphonic principle at all. It would be futile to say more on this subject.—ED. TEL. JOUR.]

Notes.

THE ELECTRIC LIGHT.—*La Lumiere Electrique* is the title of a new periodical which has just been started in Paris, under the scientific direction of the distinguished Count du Moncel. The first number is comprehensive and well illustrated, and promises well for its success. We welcome its appearance as a sign of the permanency of electric lighting.

Two electric lamps are to be fitted up in light-houses off Marseilles and the mouth of the Gironde.

DR. LYON PLAYFAIR has been elected Chairman of the Select Committee appointed to consider the subject of lighting by electricity. Scientific witnesses from all parts of the country will be summoned to give evidence. Dr. Tyndall has been already examined.

THE Albert Hall exhibition of electric lighting apparatus will be opened with a lecture by Mr. W. H. Preece, on Wednesday, May 7, and remain open until the end of the week. There will be some novelties shown.

WE hear that Werdermann's system of electric lighting has been bought by a Parisian company.

A TELEPHONE concert has been held between Terre Haute and Indianapolis, the singers being two miles apart, and the audience seventy-three miles distant. The Edison transmitter was used.

AT the Society of Telegraph Engineers' meeting, on April 23rd, Major Webber announced a new American carbon telephone, with a diaphragm of animal tissue, which gives excellent results over 70 miles of wire.

LAMBRIGOT'S TOY PHONOGRAPH.—An interesting toy phonograph, which has been contrived by M. Lambrigot, a French engineer, was exhibited by M. Hospitallier at the meeting of the Society of Telegraph Engineers on March 23. The phonogram, or vocal record, is composed of a set of parallel lead wires, with the vibrations indented along the upper surface. Speech is obtained from these by drawing the edge of a cardboard disc along them, and listening into a conical cardboard ear-piece, which is connected at its apex to the centre of the disc by a leaden wire. The phonogram is made by first impressing the speech to be registered in a mould of warmed stearine by means of a phonographic diaphragm and stylus, then getting copper electrotype of this stearine mould. Soft lead wires, pressed into this hard copper mould, give a casting of the record on the surface of the wires. These wires, with their vocal corrugations, are then arranged in parallel sets upon a board. In this way familiar sayings and mottoes may be engraved, and we fancy that some amusement might be afforded at merry makings by this simple contrivance.

LONDON FIRE TELEGRAPHS.—It is rumoured that the Exchange Telegraph Company have received orders to erect fire telegraphs in certain of the London streets.

AT a recent masquerade ball in San Francisco, a prize for the most original costume was carried off by a gentleman who was dressed as a telegraph post, twelve feet high, with a fire alarm box behind. We have much pleasure in recommending this fancy garb to the members of the Metropolitan Board of Works. Now that they have at last consented to admit fire alarm telegraphs into London, they ought to wear it with a degree of swagger and pride.

MR. APPLEGARTH, who first introduced to London the Jablochkoff, and afterwards the Rapieff electric light, is now again to the front with a new system, viz.: one in which a thermo-pile is used, and which bears the name of its inventor, Mons. E. Sudre.

THE French Government have awarded gold medals to Messrs. John E. Smythe, Horatio Pritchard, W. Leigh, and H. S. Perry, *employés* of the Submarine Telegraph Company, for their gallant assistance in rescuing the crew of the French lugger *l'Ange*, wrecked on the Cornish coast on the 1st of February last.

MR. JOHN CROSSLEY, of Halifax, the eminent manufacturer and philanthropist, died at Broomfield on April 16th.

WEATHER TELEGRAMS.—Any person may now ascertain by telegraph the actual state of the weather in any district of the United Kingdom, by wiring the Meteorological Office, London, and paying 1s., in addition to the 2s. for the message and reply. Forecasts of the prospective weather for the next 24 hours are also issued three times a day, for all parts, except the Atlantic sea-board, for which the office will only issue reports of the existing weather.

THE use of telegraph wires for messages throughout Paris will cease after May 1; M. Bontemp's system of pneumatic tubes being almost complete. Blank forms for messages will then be sold to the public, and may contain any number of words, the originals being forwarded to their destination. There will be two kinds of forms, one for open and one for closed messages, priced respectively, 50 and 75 cents.

M. VIOLLET LE DUC, the famous French architect, has submitted to the Municipality of Paris, a scheme for receiving uniform time in that city, which is likely to be adopted. Twelve centres will be established at *Mairies* and churches, from which branch wires will run to fourteen other public buildings. The twelve centres will be connected to a Standard clock at the Observatory. The cost of installation is estimated at 80,000 francs, and the management will be entrusted to the Telegraph Department, the annual expense being 7,500 francs.

THE French military authorities have been making extensive experiments at Mont Valérien with the electric light as a means of signalling, and exploring a country by night. Portable Gramme machines supply the current, and reflectors are used to direct the beams to any point of the landscape. It is believed that visual signals could be exchanged between Paris and Orleans, were the apparatus sufficiently elevated.

TELEGRAPHY IN THE GULF OF ST. LAWRENCE.—We have received from the Boards of Trade of Montreal and Quebec the Report of the Select Committee, appointed by the House of Commons of Canada, in 1876, to enquire into the possibility of establishing a system of telegraphy in the waters, coasts, and islands of the Gulf of St. Lawrence, in connection with the shipping, fisheries, and signal service of Canada. The Gulf of St. Lawrence is at present dangerous to navigation, no less than fifty wrecks having taken place on the Island of Anticosti, which bars its entrance, during the last ten years. The ice of the river, and the frequent fogs, render it hazardous for ships, especially in spring and early winter. It is therefore proposed to connect the light-houses by cables and land lines to the existing telegraphic system of the country, and to locate a powerful steamer at some central point, such as Cape Gaspé, at the northern lip of the Gulf, which can render assistance when called for by wire. Semaphores would also be erected at convenient points, to communicate with light-houses. The committee have recommended a detailed scheme, which would take a year or two to complete, and cost over 370,000 dollars. This scheme includes cable from Anticosti to the north shore of the river, from Magdalen Islands to Cape Breton, from Bird Rocks to Magdalen Islands, from St. Paul's Island to Cape Breton, and a number of land-lines, including one from Murray Bay to Mingan, 385 miles in length, one from St. Lawrence Bay to Beddeck C. Breton, 75 miles, one in Anticosti from West Point to Fox Bay, of 145 miles, and one along the north coast of St. Lawrence from Moisee to Mingan, of 100 miles. The completion of such a scheme would greatly benefit the commerce of the St. Lawrence, as well as the valuable fisheries of New Foundland, since, in the one case, insurance rates would decrease, and, in the other, the cod fishers would be able to pounce upon their prey, as the Norwegian herring fishers now do, by help of the telegraph. It is to be hoped that the Canadian Parliament will sanction this wise proceeding.

THE *Boston Post* is responsible for a report that a new invention, destined to revolutionise telegraphy, has been tried between Paris and New York at a minimum speed of 200 words per minute, and is capable of sending an entire number of the *Times* to America in *half an hour!* It is further stated, that the Anglo-American Telegraph Company offered the proprietors of this instrument £400,000 for it. If all tales are true, this is "nae lee."

COWPER'S TELEGRAPHIC PEN.—We learn from the *Journal of the Telegraph* that Professor A. E. Dolbear claims to have forestalled Mr. E. A. Cowper in devising a "writing telegraph," the same as his, with the exception that the Dolbear's receiving pen is worked by two arms, moved by the axial magnetism of two helices, instead of by galvanometer needles. The general principle of Dolbear's apparatus is said to be given in Prescott's work on the "Telephone," at page 260. We have read the passage in question, and find that it briefly describes a different arrangement altogether. In fact, it proposes to construct a telegraph in which the movement of the writing pen should thrust into or withdraw a permanent magnet from a hollow bobbin. The magneto-electric currents thus generated were intended, by a reverse action at the sending station, to move a duplicate pen. Mr. Dolbear states that he found the action of the latter pen less feeble than he expected, and abandoned the project. No one can reasonably put forward this futile idea as differing "only in a few minor particulars" from Cowper's invention, in which every element is different, and only the *object* is the same. As well call Edison's telephone the same as Bell's. As for the object of the instrument, that was conceived long ago by a Frenchman, whose plan is described in Du Moncel's earlier treatise.

THE telephone is being experimentally tried as a means of communication between the various police stations in the borough of Salford. It is found that communication can be carried on between the two stations with far greater expedition and distinctness than by the ordinary telegraph system.

A NEW telegraph company (says the American *Operator*) has just been organised in New York, with a capital of three million dollars. They propose to run lines between Boston, New York, Philadelphia, Baltimore, Washington, Chicago, and St. Louis. Compound steel-copper wire is to be used, and large poles. The President is ex-Mayor Edwin Reed, of

Bath, Me. The organisation is designed to keep the company from falling under the control of "monopolists." It hopes to transmit 1,000 words per minute over its compound wires, and 500 over the ordinary ones now in use.

A NEW working contract has been signed between the W. Union Telegraph Company, and the New York, Lake Erie, and Western Railroad Company, for the telegraph lines of the latter.

EDISON'S INDUCTION DEVICES.—We have received from Mr. Edison, a copy of his United States Patent for "Circuits for Acoustic or Telephonic Telegraphs," No. 203,019, dated April 30, 1878. It describes several modes of compensating for the induction of neighbouring working circuits on a telephone line, by means of coils, electro-magnets, and condensers. Inasmuch as these are always permanently connected in circuit, his method differs from that of Professor Hughes, we have described in recent numbers. Professor Hughes reverses the ends of the compensating coils in the circuit by the signalling key itself in the act of signalling; his method not being specially designed for the protection of a telephone line, but of each ordinay circuit against all the others. Mr. Edison, however, does not confine his plans to telephone circuits. Another point of distinction between his methods and that of Professor Hughes, is the formation of the induction compensator itself. Professor Hughes arranges his coils with respect to their position, distance from each other, and length of wire, so as to imitate the actual disposition of the line wires. We cannot see that Mr. Edison has arrived at this idea. His specification, however, covers a good deal of Professor Hughes' preliminary work.

MOST people would say that there is little poetry in a telegraph post: nevertheless, Thoreau, the nature-poet of America found a great deal of the genuine frenzy in it. "What a receipt for preserving wood," he cries, "to fill its pores with music! How this wild tree from the forest, stripped of its bark and set up here, rejoices to transmit this music! When no melody proceeds from the wire I hear the hum within the entrails of the wood, the oracular tree, rejoicing, accumulating the prophetic fury. The resounding wood, how much the ancients would have made of it! To have had a harp on so great a scale, girdling the very earth, and played as by the winds of every latitude and longitude, and that harp were (so to speak) the manifest blessing of heaven on a work of man. Shall we not now add a tenth muse to those immortal nine, and consider that this invention was most divinely honoured and distinguished, upon which the muse has condescended to smile—this magic medium of communication to mankind?"

LARTIGUE'S MERCURY COMMUTATOR.—This ingenious contrivance, as described by *Engineering*, consists of a water-tight box made of insulating material, such as glass, porcelain, ebonite, or gutta-percha, and contains a quantity of mercury which, according to the position of the box, makes or breaks the contact between platinum electrodes whose position is determined according to the requirements of the case. The box may be divided into two or more cells of different sizes, insulated from each other, or communicating by orifices cut in the partitions. By this means the duration of the closed circuits may be regulated by the time taken by the mercury in passing from one cell to another. The commutator can be used in water or under conditions in which the ordinary keys would fail. In France the Northern Railway Company have adopted it as a water level indicator for tanks, an automatic pedal alarm for approaching trains, and an indicator for way points worked at a distance. It is well adapted for rough out-door work.

CONTACT ELECTRICITY.—Prior to the experiments of Professors Ayrton and Perry in 1876 all attempts to measure the difference of potentials generated by the mere contact of a solid and a liquid or two liquids with each other were more or less inaccurate. For example, Kohlrausch instead of using pure liquid surfaces, employed blotting paper moistened with the two liquids to be tested. These investigators have, however, designed an apparatus which measures the electro-motive force generated by contact of two liquid surfaces. It has usually been thought that the electro-motive force was almost inappreciable compared with that obtained from contact of metals in contact, but they find that strong sulphuric acid in contact with distilled water, solutions of alum, copper sulphate, and zinc sulphate has a measured difference of potentials of 1·3 to 1·7 volts, which, according to them, is more than twice as high as that of zinc and copper in contact.

MODIFICATIONS OF AMPERE'S LAWS.—Max Margules has communicated to the Vienna Academy the results of his researches upon "The Theory and Application of Electro-Magnetic Rotation," which he embodies in the two following laws:—1. If a pole of a magnet rotates in the neighbourhood of an unclosed conductor, about an axis which is within the magnet, a current will be induced within the conductor; but if a rectilineal conductor is turned about its own axis, in the neighbourhood of a magnetic pole, no current will be produced in it. 2. The rotation of a magnetic pole around a rectilineal conductor induces no current, but the rotation of the conductor about the pole produces an induced current. The first portion of the first law is a simple inversion of Ampere's statement of the law of electro-magnetic rotation; it has also been demonstrated by F. E. Naumann, and adopted as a fundamental law of the phenomena of uni-polar induction. But W. Weber, who first specially investigated the phenomena to which Faraday invited attention, disputes the sufficiency of Ampere's explanation of the rotation of a magnet on its own axis when it is traversed by a galvanic current.—*Ann. der Phys. und Chem.*

AN AUTOMATIC CURRENT REGULATOR.—This apparatus, the invention of M. Hospitalier, and presented to the French Academy of Sciences by M. Du Moncel, consists of a resistance coil of a single layer of turns of which the wire is bared for a space of about a centimetre wide. A slightly convex lever, which forms a sliding contact is applied to the bare part of the wire. This contact is connected at one of its extremities to an armature placed in front of an electro-magnet, in which circulates the current which is meant to be regulated. An antagonistic spring withholds the lever at its other extremity. The circuit is formed by the resistance coil, the lever, and the electro-magnet. The apparatus being regulated for a given intensity, the sliding contact introduces into the circuit a certain number of the turns of the coil. If the current increases the electro-magnet attracts its armature more strongly the contact shifts its point, and introduces into the circuit a greater number of turns of the coil; the resistance increases, and the strength of the current diminishes accordingly. If the current decreases below the standard strength the reverse effect takes place. Practically, this device may prove useful in galvanoplasty, in the incandescence of platinum and iridium wires to prevent fusion, and the introduction

of the electric light into homes. A simple and effective contrivance of this kind is worthy of an inventor's attention just now.

ELECTRICITY IN AIR.—Recent experiments of M. R. Nahrwold tend to demonstrate that it is the dust in air and not the air itself which becomes electrified. When air is sifted of dust by means of glycerine, it takes only a very feeble charge. M. Nahrwold also remarked that positive electricity discharges itself more readily in air than negative, a result contrary to those of Wiedemann and Ruhlman, and we think also of Thomson. During the electric discharge, when viewed by the light of the mechanical theory of gases, would seem to show that the discharge, besides increasing the *vis viva* of the moving molecules, also increases the *vis viva* of the oscillatory motion of the ether envelopes. Different spectra got from different points in the width of the gaseous tube are therefore not to be referred only to the different temperatures of the gas, but to the amounts of electricity of which the passage causes the oscillation of these ether envelopes.

ELECTRIC LUMINOSITY OF GASES. — M. Eilhard Wiedemann from experiments made by passing discharges from a Ruhmkorff induction-coil excited by two Bunsen cells through a tube filled with air, has determined that a gas may become electrically luminous by the passage of electricity through it, while yet at a temperature far below 100° C. Indeed, 62° C. is not the lowest temperature at which a gas may emit light under this condition.

AN electric water-level indicator has been fitted up by the Silvertown Company at the New Water Works, Leamington. A rise or fall of the water level applies the positive or negative pole of a battery to the indicator for a certain time, and causes the hand to indicate the new level in feet. A similar instrument, designed by the Postal Telegraph Engineers, was fitted some months ago to a reservoir of the Nottingham Waterworks Company, and has given great satisfaction.

New Patents—1879.

1476. "Telephones and telephonic call mechanisms." H. J. HADDAN (communicated by A. M. Rosebrugh). Dated April 16.

1477. "Telephony." H. J. HADDAN (communicated by G. Black, and A. M. Rosebrugh). Dated April 16.

1531. "Improved arrangements or apparatus for telephonic and microphonic purposes." J. W. T. CADETT. Dated April 18.

1549. "An improved method of forming matrices for electro-typing line and pattern rules, and in appliances used therefor." D. CULROSS. Dated April 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1878.

3622. "Submarine electric telegraph cables." WILLOUGHBY SMITH. Dated Sept. 13. 4d. This invention consists in forming cables of light specific gravity, such that their strength shall not be impaired by long immersion. The conductor is coated with gutta-percha in the ordinary manner, but a steel wire sheathing is laid round it in long open spirals, and imbedded in the outer coating of insulating material. This outer coating may be a mixture of gutta-percha and shellac, and the wires may be imbedded either by heating them or the material.

3744. "Telegraphing on board ship." E. A. CAMMADA, of Delft, Holland. Dated Sept. 21. 6d. A series of thirteen electro-magnets are arranged round a circle, and the signal is made by actuating any one of these by the current, so that it attracts an armature and lever over the electro-magnet in question. A dial indicates the motions of the armature and the command. This contrivance can be applied to steering.

Proceedings of Societies.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on the 22nd of April, Mr. BATEMAN, President, in the chair, the Paper was read on "Dioptric Apparatus in Light-houses for the Electric Light," by Mr. JAMES T. CHANCE, Assoc. Inst. C.E.

The author briefly premised that in the Fresnel or dioptric system, the source of light occupied the central position within a structure of glass zones, or annular segments, by which the incident rays were condensed and directed on the sea; and that there were two principal kinds of dioptric apparatus, the fixed and the revolving. He then proceeded to make some observations concerning the different optical treatment which a small radiant like the electric arc required from that which suited an ordinary flame. In the latter case, as, for it concerned sea-lights, the object was not only to parallelise all the rays emanating from any point of the luminary, but also to reduce the vertical divergence due to the height of the flame by increasing the diameter of the optical instrument. On the other hand, the smallness of the electric arc afforded the opportunity of obtaining from the dioptric zones or other elements, by suitable generating sections, whatever divergence, whether horizontal or vertical, might be desired. It was also pointed out that the source of light, in the case of the electric arc, could not be entirely depended upon for maintaining the same position in relation to the focal horizontal plane; and that consequently, since the vertical divergence due to the luminary would move upwards or downwards with any vertical displacement of the radiant itself, the mariner could not be absolutely secured from failing to see the light, unless a special vertical divergence were given by the dioptric apparatus, independently of that caused by the size of the electric arc. This, however, involved the adoption for this illuminant of a dioptric instrument considerably larger than what was originally contemplated, so as to reduce materially the luminary divergence, and thereby be free to substitute for it, to some extent, a special vertical divergence.

The author stated, that in 1862 he had expressed himself in favour of a much larger apparatus than was then employed with the electric light at Dungeness. Also that in 1865, Messrs. D. and T. Stevenson had recommended a third order apparatus for the purpose, in their report to the Commissioners of Northern Light-houses. A similar result was arrived at by the Elder Brethren of the Trinity House, in 1869, in consequence of comparative trials instituted by Professor Tyndall, for testing the relative merits of a sixth order light, and a third order respectively, when used with the electric radiant.

The Souter Point Revolving Light, which was first exhibited in January, 1871, was described. Reasons were assigned for adopting two optical agents—one to condense the light in the vertical plane, the other to produce the required horizontal compression—instead of attempting, even for the refracting part of the apparatus, to effect the two condensations respectively

by a single agent. Reference was made to the proposal of Mr. Thomas Stevenson, M. Inst. C E., for attaining this latter desideratum; as likewise to that of Mr. Brebner, M. Inst. C.E., with a similar object. The method actually adopted was similar to that which had been already employed in France for the revolving light with the electric arc. It consisted of a fixed third order light encircling 180°, and of a rotating octagonal drum of the same height surrounding it. Each side of this drum, comprising three panels in height, was composed of vertical refracting prisms, by which the light, radiating in azimuth from the inner fixed apparatus, was compressed horizontally into a beam of 7° 8' divergence in addition to that due to the diameter of the electric arc. This was done in such a manner that every single prism had its own independent divergence of the same amplitude, whereby was obtained an extent of light-emitting surface of a height of 6½ feet and of 22½ inches in breadth. Stress was laid upon its being the characteristic feature of the beam issuing from any one of the sides of this glass drum that, in passing before the eye of the observer at sea, its brilliancy would, from first to last, remain unchanged, as distinguished from the waxing and waning appearance of the ordinary revolving light; consequently, at whatever distance the flash might be visible, the interval of its duration would be the same. Attention was also directed to the valuable suggestion made by Mr. J. N. Douglass, M. Inst. C.E., the Engineer to the Trinity House, that advantage should be taken of the landward hemisphere of the radiant light of the electric arc, to provide a beam which should be made to issue through a window in the tower below the main light, in order to mark certain dangers in Sunderland Bay; and it was stated that 54·6 per cent. of the rearward hemisphere of light had been thus utilised.

The two fixed lights which were inaugurated at the South Foreland, in January, 1872, were described. It was explained how the whole of the catadioptric zones—both upper and lower—were in both lights made to parallelise the rays in the usual manner. The light, however, incident on the refracting portion of each light was distributed over the sea from the horizon to within a short distance from each tower, by a succession of increasing angles of vertical divergence, so that the illumination of the sea became gradually diminished as the distance from the land was lessened. In each light there was a rearward arc to spare, and this was turned to valuable account, from 67 to 71 per cent. of this light being collected and acted upon by optical agents, which were particularly described, as thereby distributed uniformly over the front azimuthal arc, so as to intensify not only the illumination of the horizon and the distant sea, but also that of the nearer sea.

It was mentioned that the two Lizard Lights, which were both fixed, and were first exhibited in March, 1878, had optical arrangements similar in every respect to those adopted at the South Foreland Light-houses, with a slight variation in the refracting portions, arising from the circumstance that existing apparatus had to be turned to account in the construction of each apparatus.

A table was appended, showing the condensing powers in the direction of the horizon of the lights described in the paper, distinguishing those optical portions which parallelised the incident light from those which gave to it special vertical divergence. According to this table, upon the assumption that the diameter of the electric arc was 12 millimetres, the condensing powers in the sea-horizon direction were as follow:—

Souter Point—Revolving - -	236·38
South Foreland—High Fixed - -	50·17
South Foreland—Low Fixed - -	43·40
Two Lizard Lights—Fixed - -	58·44

and data were added for adopting this Table to particular cases.

In a second table was given the respective condensing powers over the near sea, at different distances from the light-house towers.

THE SOCIETY OF TELEGRAPH ENGINEERS.

At the ordinary general meeting of the society held April 23rd, Major Bateman-Champain, President, in the chair, a Paper was read by Mr. ADAM SCOTT, on "Recent Improvements on Professor Bell's Telephone."

In commencing his paper, Mr. Scott said that since Professor Bell's paper, no communication on the subject of that gentleman's telephone had been made to the society. Since that period very great success had attended the use of the instrument, especially in America, where no less than 26,000 telephones were in daily use at an annual rental. The exchange system by which different telephonic circuits could be switched through to any other circuit at a central depôt, was in active use. At Chicago, 700 subscribers worked their telephonic lines on that system, and the number of calls made through the central office exceeded 8,000 daily. Referring to the limited use of the instrument in England, where the number employed was stated not to exceed 500, Mr. Scott said that bad management was the cause that had checked the general introduction of the instruments into use. Also it was his opinion that the public had formed an erroneous judgment of the capabilities of the telephone from having heard instruments of an inferior manufacture. Telephones, although simple in principle, required to be constructed with care and good materials, otherwise they were sure not to give continual satisfaction; the magnets of such instruments were far too weak and too small, and the diaphragm being consequently set too near the pole of the magnet, frequently became bound against it by change of temperature. The magneto bell calls tried were also found to fail, and even battery calls could not be relied on in the hands of inexperienced persons.

Mr. Scott then described the telephone of Mr. F. A. Gower,* pointing out its several advantages. The use of a flexible mouth and ear tube allowed the telephone to be fixed, and consequently all liability to the connecting wires becoming broken was avoided; also the introduction of a call consisting of a vibrating reed caused to vibrate by blowing through the tube was a great improvement. The magnets of this telephone were of French steel of a highly porous nature, and were capable of sustaining ten times their own weight; the diaphragm also was thicker than that usually employed, and the whole being enclosed in a strong metal box was not affected by climatic changes.

At the conclusion of his paper, Mr. Scott practically demonstrated the capabilities of the instrument, and showed that the voice could be heard even if the speaker stood several feet distant from the instrument.

In the discussion which followed the reading of the paper,

Mr. PREECE pointed out that every disc of the telephone had its own fundamental note, and that a voice sounded in that key could be most distinctly heard. Referring to the comparative use of the instruments in America and England, Mr. Preece agreed with Mr. Scott that bad management had checked its use in England, but at the same time, said that the number in use considerably exceeded 500, as a large number were employed which did not pay a royalty. He thought that the extensive use of telephones as well as call instruments in America, was due to necessity, as it was

* See TELEGRAPHIC JOURNAL, March 1st, p. 75.

difficult there to obtain errand boys to carry messages. The difficulties which ensued from induction on lines when fast speed instruments were employed was also pointed out as a reason why the telephone was not extensively employed.

Major WEBBER criticised some of Mr. Preece's remarks as to the effectiveness of the telephone, and pointed out the use that was made of it by the telegraph lineman when searching for a fault, the telephone enabling them to communicate readily with the nearest station.

Lord LINDSAY in speaking of the question of induction between telephonic and other circuits, stated that a telephone circuit which run parallel to other circuits for a few yards, and six yards distant, was distinctly affected by the currents in the other wires. He had found the telephone a very useful instrument.

Professor AYRTON pointed out that the diaphragms of telephones should be of such dimensions as not to be able to vibrate slowly, in fact, should have a "dead beat" action. He suggested two diaphragms with a viscous liquid between them as likely to effect this object.

Mr. SCOTT in replying to an objection raised with reference to the use of the flexible tube, stated that its employment so far from being prejudicial was quite the reverse, as it improved the articulation to some extent.

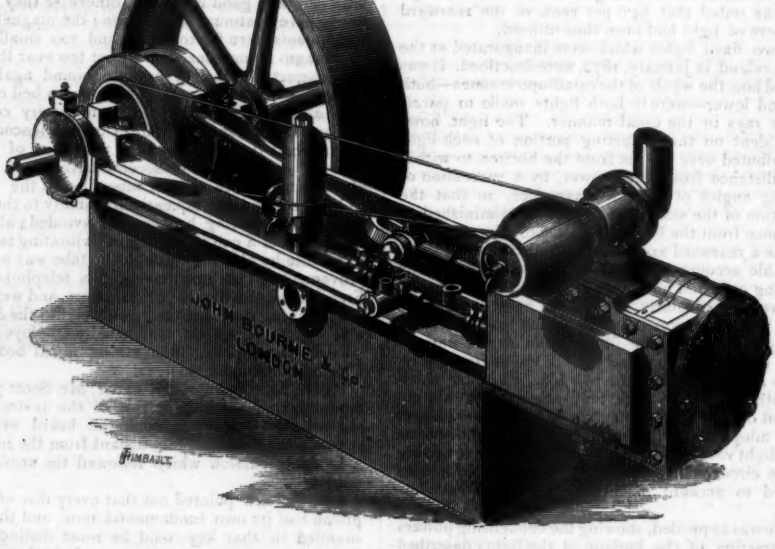
General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

IV.

Bourne's Balanced High-pressure High-speed Engine.

IT has long been maintained by Mr. Bourne that the steam engine of the future would be one which is driven at a high-speed, the moving parts being all



designed so that no unbalanced momentum may cause a tremor.

The benefits which the high-speed system possess are numerous; not only is the noise and complication of gearing avoided, but, as an engine with any given pressure of steam will generate a given amount of power at each stroke, whether the strokes per minute be many or few, it is clear that the amount of power generated by a given engine in a given time will be in the simple ratio of its velocity; and hence a given power may be generated with less first cost, with less weight of metal, and with less space occupied by a fast engine, than by a slow one.

Again, the benefit of working steam engines expansively is well known to engineers, as also the necessity of employing a steam jacket in engines so worked, to obtain the full benefit of the expansive principle. It is not generally known, but is nevertheless the fact, that in high-speed engines there is a further benefit arising from the inability of the cylinder to become sensibly heated and cooled at each stroke, from the shortness of the time given for that process, and in such engines the cylinder approaches to the condition of a non-conductor, which is known to be favourable to the economical generation of power. Then, in the case of all high-pressure engines, it is easy to see that a considerable pressure must be more beneficial than a lower

pressure. To raise a given quantity of water into steam takes just the same quantity of heat, whether the evaporation is effected at the pressure of the atmosphere or at six or eight times that pressure. But at the low pressure the steam will not generate any power, whereas at the high pressure it will generate much power. A very high pressure of steam, however, is inconvenient, as it involves a correspondingly strong and heavy boiler, an extra strong and heavy engine, and separate expansion gear, which is not compensated by the small amount of increased economy obtained from excessive pressure. A pressure of about eight atmospheres is found to be, on the whole, the most eligible that can be adopted.

The figure shows one of Mr. Bourne's high-speed engines, employed in generating the electricity for the electric light at the Polytechnic Institution, in Regent Street.

The proportions of these engines for all powers is as follows :—

Extreme length of engine, about 8 times the length of stroke.

Extreme breadth of engine, about 5 times diameter of cylinder.

Breadth of fly-wheel for strap, about 1½ times diameter of cylinder.

Diameter of vertical boiler, about 8 times diameter of cylinder for small, and 6 times for larger powers.

Height of boiler, about 2½ times its diameter.

Working pressure in boiler, 120 lbs., tested to 240 lbs.

Water required for feed, about ½ cubic ft. per *indicated* horse-power per hour.

Coal consumed, about 3½ lbs. per *indicated* horse-power per hour.

In addition to the engines, which have been already described, those manufactured by several other firms are worthy of notice, as being especially adapted for driving electric-light machines, amongst others, the engines of Messrs. Marshall, Sons, & Co., of Gainsborough, and also Messrs. Tangye, of Birmingham. Messrs. Marshall's engines are fitted with patent automatic expansion gear, which insures the greatest regularity in the working.

City Notes.

Old Broad Street, April 28th, 1879.

THE competitive Atlantic telegraph scheme mentioned frequently by us, now appears to be rapidly entering on the field of action. There will doubtless be a gigantic struggle between the two combined companies and that which is about to lay two other cables between France, England, and America. It is almost needless to say the interest taken in the matter is growing fast, the large capitals involved in the older enterprises, rendering the intended competition a most serious matter for the shareholders in them. With the Direct United States Company, we all know what happened; the shares were depressed by low tariffs and they were then bought up by some prominent members of the antagonistic company. The voting majority having been thus obtained, it became then a comparatively simple matter to amalgamate (practically) the two undertakings. Doubtless this has been provided against in the formation of the new company, the shares being in the hands of a few large holders. It remains then to be seen what will be done by the antagonists. If low tariffs prevail, the company with the heaviest load of capital would suffer most, supposing the traffic shared equally; but this at first could hardly be the case. The exact proportion which the new company will take depends on various circumstances, difficult to estimate beforehand. It will, however, have an immense advantage in the services of M. Von Chauvin, who gained so much experience in the late Anglo and Direct war; his clever management of the latter company during that contest is fresh in the memory of most of us. Lord Monck, the other day stated, that the "Anglo and Direct Companies had by special agreements the right to bring almost every message which crossed the Atlantic from America here; and they had priority in, he believed, all European countries over any other company which might exist—that was to say, the governments of all European countries, France included, were bound to send all messages transmitted to them by these two companies' lines, unless the sender directed to the contrary." We have not the slightest doubt that M. Pouyer Quertier and his colleagues, have well considered this part of the question, the want of *common sense*, mentioned by the noble lord, notwithstanding, they probably have well studied everything in connection with it, and we shall look with interest for the result of the forthcoming inevitable struggle. The public, no doubt, will be glad of low tariffs, and if all three companies can with these, pay dividends and provide reserve funds, so much the better for all concerned. This, however, we fear, will not be done.

WEST COAST OF AMERICA TELEGRAPH COMPANY.—The second ordinary general meeting of the shareholders of this Company was held on Thursday, the 10th inst., at the offices, No. 98, Cannon-street, under the presidency of Mr. Neil Bannatyne. An abstract of the report appeared in our last issue. The Chairman, in moving its adoption, said the report was rather long. The directors had gone as fully as possible into all matters connected with the Company, so that the shareholders might have as clear an idea of the exact position of the concern as the directors were able to supply them with. The report was, therefore, so full that, if he made any further observations at that moment, he should only recapitulate the statements it contained. He would, however, be happy to reply to any questions, and, in that manner, perhaps, give further information. The motion having been seconded, Mr. Small said that the capital was stated at £300,000, while the cost of the cables, land lines, and instruments was set down at £425,000. He regretted that there was £150,000 debentures, the interest on which had to be provided before the ordinary shareholders received anything. He feared it would be some time before they received anything. Dr. Beattie was not so despondent. The debenture-holders had voluntarily relinquished 2 per cent. of the interest to which they were entitled, and now received only 8 per cent., and with an improvement in trade he trusted that the ordinary shareholders would receive some dividend. He asked how the steamer, the *Retriever*, was employed. Another shareholder asked what effect the war between Chili and Bolivia would have on the Company's traffic. The Chairman, in reply, said that the balance-sheet clearly showed the amount of the capital and how it had been expended, and it also showed what really were the assets of the Company representing the capital. The object of the directors had been to place the accounts on as sound a basis as possible, and they had written off out of revenue all the preliminary expenses of forming the Company, and the working expenses of the steamer preparatory to her being placed on the station; so there were no assets which were not really available

assets. When they had a surplus of revenue they would be in a position to pay a dividend on the ordinary shares. They could not prophesy when they would be able to pay a dividend on the ordinary shares—it depended entirely on their traffic. When the cables were laid down business was in a more active state in Peru than had been the case ever since, and the traffic had certainly not come up to the expectations originally formed of it, partly from this cause and partly from another cause not within their control—the interruptions to neighbouring lines. The steamer had made one voyage carrying water, and she had also been employed in carrying cargo and towing. She was fitted up and ready for employment in any of the ways stated in the report. She was an excellent vessel. All their cables were in working order, and the cable in store was in perfect electrical condition. They could not tell what effect the war between Chili and Bolivia would have on their traffic, but he thought he might say that for the present month it would have a very favourable effect on the local traffic. The debenture interest was 8 per cent. on £150,000. Any one could see what that amounted to, and the position of the ordinary shareholders as to dividend. Their expenses were excessively small, and it would be their policy to keep them down as much as possible consistent with efficiency. Mr. Gray remarked that the Company's cables extended from the capital of Peru, past Bolivia, on to the capital of Chili, Valparaiso, touching at various intermediate posts. Before war was declared they were asked to connect Autofogasta, one of the Bolivian ports. He then referred to the causes out of which the war arose, and afterwards stated that there would probably be one length, from Autofogasta to Iquique, through which no messages would go; but he anticipated a great local traffic. He felt satisfied that neither of the Governments would injure the cables, because in peace they derived such great benefits from them. In fact, the Presidents of Chili and Peru had told him that they would do all they could to preserve the cables. The report was then unanimously adopted. The other business was disposed of, and the meeting closed with the usual complimentary vote.

SUBMARINE CABLES TRUST.—According to the Report of the Trustees, the revenue for the year was £26,165, from which £1,890 was expended in the purchase of twenty certificates, and £2,000 has been deducted for expenses, leaving a balance of £22,275. Of this sum £10,362 has been applied to the payment of the coupons due on October 15th last, and the balance of £11,913 is carried forward. The amount required to pay the coupon on the 15th inst. is £10,362.

The Western and Brazilian Telegraph Company (Limited) notify that telegrams for Chili, Bolivia, and Peru are subjected to a scrutiny by the authorities in Valparaiso, and stopped or forwarded according to their discretion. The authorities in Valparaiso also intimate that no refund will be made for messages so stopped. This company likewise announce on April 25th, the repair of their Para-Maranham section.

In order to promote the carrying out of an arrangement concluded between the Telegraphic Administrations of Germany and Norway, a company was constituted on April 23rd, in the office of the United German Telegraph Company for the laying and maintenance of a cable between Germany and Norway.

Direct United States Cable Company (Limited). The Board of this Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of five per cent. per annum, for the quarter ending March 31st last.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 55-55½; Ditto, Preferred, 84-85; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6½-6⅞; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10-10½; Direct United States Cable, Limited, 1877, 10¾-11¼; Eastern, Limited, 7½-7¾; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 100-103; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China Limited, 7½-7¾; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10¾-11¼; Great Northern, 7¾-8¼; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9¾; Reuter's, Limited 9½-10½; Submarine, 220-230; Submarine Scrip, 1¾-2¼; West Coast of America, Limited, 1¼-1⅝; West India and Panama, Limited, 1¼-1¾; Ditto, 6 per cent. First Preference 8½-9; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 3¾-4; Ditto, 6 per cent. Debentures "A," 93-97, Ditto, ditto, ditto, "B," 87-92; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 29½-30; Ditto, 6 per cent. Bonds, 107-109; Ditto, Second Bonus Trust Certificates, 2⅜-2½; India Rubber Co., 10¼-10¾.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £495,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
March, 1879 ...	47,550	13,052	3,100	929	15,850	41,225	26,185	15,401	... ...	9,790	... ...	11,688	5,191
March, 1878 ...	48,630	14,239	3,517	880	11,580	38,201	23,112	18,156	... ...	10,055	3,425	12,300	6,377
Increase	... ...	... ...	... ...	49	4,270	3,024	3,073	... ...	... ...	... ...	... ...	... ...	... ...
Decrease	1,080	1,187	417	... ...	... ...	... ...	... ...	2,755	... ...	265	... ...	612	1,186

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)